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TITLE: WASTE CHARACTERIZATION AT LOS ALAMOS NATIONAL LABORATORY

AUTHOR(S): JUAN C. CORPION AND ANTHONY R. GRIEGGS
ENVIRONMENTAL PROTECTION GROUP
HEALTH, SAFETY, AND ENVIRONMENT DIVISION
(HSE-8)

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Los Alamos National Laboratory
Los Alamos, New Mexico 87545

# WASTE CHARACTERIZATION

# AT

# LOS ALAMOS NATIONAL LABORATORY

# (LANL)

*Juan C. Corpion and Anthony R. Grieggs*
*Environmental Protection Group*
*Health, Safety, and Environment Division*
*Los Alamos National Laboratory*

**Abstract**

*Most industries generate limited types of solid wastes as a result of their manufacturing processes. The Los Alamos National Laboratory (LANL), a research and development facility, generates a large variety of solid wastes, some exotic. Over 50,000 distinct waste streams are currently generated in the 43 square mile area defining LANL. These wastes include refuse, medical, infectious, hazardous, radioactive, and mixed wastes. LANL is subject to federal and State oversight on matters concerning management of solid wastes. In order to assure regulatory agencies such as the New Mexico Environment Department (NMED) and the U.S. Environmental Protection Agency (EPA) that the Laboratory is properly managing and disposing all solid wastes, LANL has undertaken an extensive waste characterization program to identify sources and ultimate disposition of all solid wastes.*

*Given the number of solid waste streams expected, LANL has taken a two-pronged approach to characterizing wastes: a) physical identification of all sources of solid wastes including interviews with waste generators; and b) characterization of wastes from the point of generation. The former approach consists of canvassing all structures within the LANL complex, interviewing waste generators, and identifying sources of waste generation. Data gathered by these interviews are compiled in a database in order to identify the types and rates of waste generation and correct mismanagement of wastes identified during the interviews. The latter approach consists of characterizing all solid wastes which are controlled administratively or subject to stricter controls than municipal solid wastes (i.e., infectious, hazardous, radioactive, and mixed wastes). This characterization forms the basis by which LANL will manage solid waste in accordance to NMED/EPA regulations and U.S. Department of Energy Orders.*

## Introduction

Environmentally-sound methods of disposing and reducing solid and hazardous waste became a national priority during the 1980s. Public concern for the state of the environment has given rise to political scrutiny of waste management practices at federal facilities, particularly Department of Defense (DoD) and Department of Energy (DOE) installations. The Los Alamos National Laboratory (LANL) is owned by the DOE and operated by the University of California. Unlike many DoD and DOE facilities which generate wastes from production or maintenance activities, the majority of wastes generated at LANL, as a result of the primary mission of the Laboratory - research and development, vary greatly from time to time.

The Los Alamos National Laboratory (LANL) is located in north central New Mexico on the Pajarito Plateau, situated west of the Rio Grande on the eastern slopes of the Jemez Mountains. LANL encompasses approximately 43 square miles (111 $km^2$) and 32 active Technical Areas (TA).[1] A TA is a defined area in the Laboratory where specific missions are performed. These missions include national security, space and defense research, environmental studies, and medical research, among others.

LANL is subject to the New Mexico Hazardous Waste Act which adopted federal codes promulgating Subtitle C of the Resource Conservation and Recovery Act of 1976 (RCRA). Because the Laboratory treats and stores hazardous wastes on-site, LANL applied for, and received, a RCRA Hazardous Waste Facilities Permit from the State of New Mexico on November 8, 1989.

Hazardous wastes are solid wastes which either exhibit a hazardous characteristic, or have been listed by the EPA as hazardous.[2] The EPA has identified four hazardous characteristics: 1) ignitability, 2) corrosivity, 3) reactivity, and 4) toxicity, based on EPA's Toxicity Characteristic Leachate Procedure (TCLP). Listed hazardous wastes include process waste streams and unused chemical compounds, of these, there are two process waste stream categories: specific source and non-specific source. Unused chemical compounds have been broken down into hazardous and acutely-hazardous. Many of the activities performed at LANL result in the generation of several of these characteristic and listed hazardous wastes (figure 1).

## I. Source Characterization

The most effective method of characterizing waste generated at LANL is to visit all areas of the Laboratory and identify every source of solid waste generation. In accordance with the Hazardous Waste Facilities Permit, Attachment I, this effort was begun in the fall of 1989 and should be completed by the end of 1991. Current

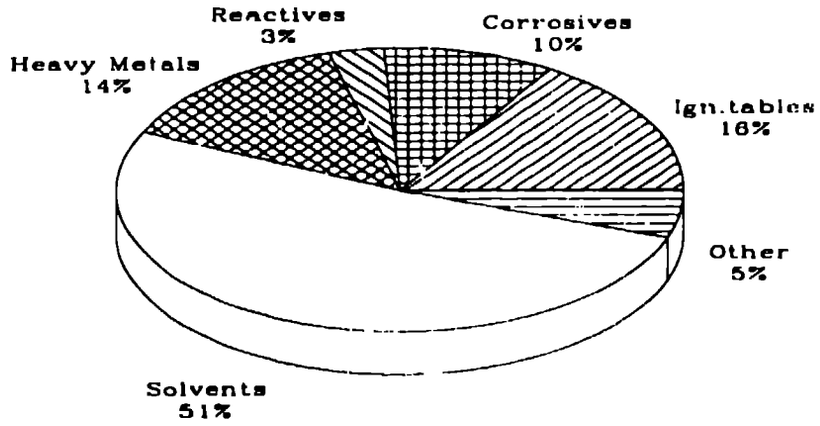


Figure 1. Distribution of Hazardous Wastes Generated in 1990.

estimates of waste streams identified by this study range from 50,000-75,000, including effluent subject to the Clean Water Act and emissions subject to the Clean Air Act. In order to manage such a large amount of data, a large-scale Structured Query Language database has been developed to facilitate efficient sorting and extracting of data, thus accelerating remediation of waste disposal problems.

The source characterization study will be instrumental in effecting waste minimization by eliminating needless contamination of solid wastes with listed hazardous wastes, and identifying hazardous substances that can be readily substituted with non-hazardous products that have similar properties. Two projects already underway at LANL are elimination of halogenated and non-halogenated organic solvents from the Laboratory's low-level wastewater treatment facility, and substitution of chlorinated hydrocarbons by turpene-based solvents at several machine shops.

A. Low-Level Wastewater Treatment Facility

The Laboratory operates a wastewater treatment facility which removes dissolved radionuclides from wastewaters derived from TAs which handle radioactive materials. This facility is not subject to RCRA because it is regulated by the Clean Water Act (CWA) through a current National Pollutant Discharge Elimination Permit System. Effluent discharges subject to the CWA are exempt from RCRA regulations. However, sludges from the wastewater treatment facility are subject to RCRA if they exhibit a hazardous characteristic or if the influent contains hazardous constituents derived from the disposal of listed hazardous wastes.

In the case of LANL's low-level wastewater treatment facility, a few listed hazardous waste constituents have been found in the sludge. These constituents include methylene chloride, 1,1,1-trichloroethane (TCA), and toluene. The highest concentration detected is approximately 400 parts per billion (ppb) methylene chloride. TCA and toluene have been found at no greater than 100 ppb. The occurrence of these organics do not necessarily indicate that the sludges are mixed wastes (radioactive hazardous wastes), however. These substances are regulated as non-specific source process wastes (F001, F002, and F005) if the concentration of any of these organics were greater than 10% before use as solvents. Therefore, the existence of these organics do not necessarily imply that the sludges are mixed wastes because of the 'Mixture Rule'. This Rule, defined in the Code of Federal Regulations 40 (40 CFR) Part 261.3(a)(2)(iii), exempts a mixture of a solid waste and a listed hazardous wastes listed solely for a characteristic from hazardous waste regulations. Generally, hazardous wastes listed for ignitability or reactivity may be readily exempted by testing. Methylene chloride, TCA, and toluene, however, are listed as hazardous wastes because of toxicity. The EPA, to date, has not established a regulatory level for toxicity of these compounds. Therefore, unless it can be proven that these organics were derived from non-regulated sources, or that an exemption provided in 40 CFR Part 261.3(a)(2)(iv)(B) (i.e., usage less than 25 parts per million of the average total weekly flow into the headworks of the wastewater treatment facility), the sludges must be regulated as mixed wastes. The Laboratory may also exercise its option to petition the EPA to 'de-list' these wastes from RCRA regulation.

The source characterization study will be instrumental in identifying all sources of influent into the wastewater treatment facility. If as a result of characterizing the sources of influent, methylene chloride, TCA, and toluene are found to have been used in non-regulated activities, the sludges may be reclassified as non-hazardous. Second, if the total concentration of these organics compounds are found to contribute less than 25 parts per million of the average total weekly flow of the influent, the sludges may also be deemed non-hazardous. Lastly, if options 1 and 2 fail, the Laboratory will have acquired essential data to proceed with a de-listing petition.

B. Solvent Substitution

LANL has several large machine shops which provide common and specialized machined products in support of research projects throughout the Laboratory. These machine shops use several thousand gallons of non-hazardous coolants and oils a year to lubricate tooling machines. Cutting oils and solvents which are widely used to create and finish machined products have contaminated the oils and coolants; and have caused them to become regulated as hazardous wastes because of the same Mixture Rule which affects the low-level wastewater treatment facility. The estimated costs of treating these contaminated coolants and oils in a manner appropriate for hazardous wastes in 1990 exceeded $250,000, excluding on-site labor and transportation costs.

The growing costs of treating and disposing halogenated organic solvents has popularized the use of Turpene-based and other non-hazardous solvents. Turpenes have been available for several decades but were shunned in favor of halogenated solvents and cutting oils because of inferior vapor pressures and residues. Turpenes are a family of naturally-occurring organic compounds found in vegetation such as citrus fruit. Many turpenes are biodegradable. A few turpenes may become hazardous wastes when used because of low flash points (ignitability

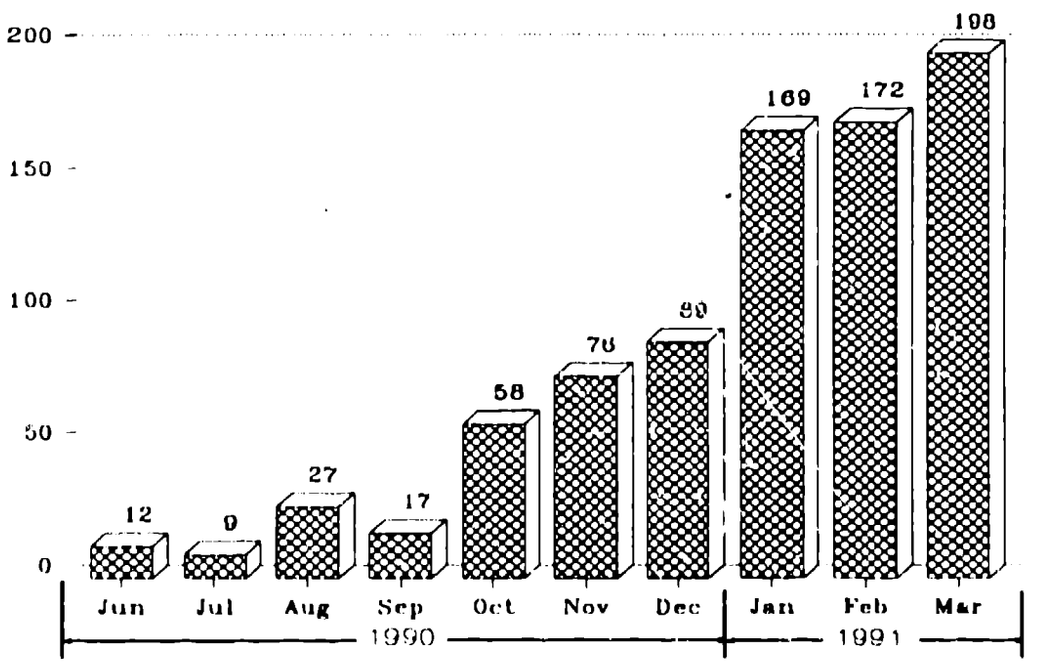


Figure 2. Number of waste profiles submitted for review since June, 1990.

characteristic). Nevertheless, they are significantly less hazardous to human health and the environment. Many of the machine shops at LANL have begun switching to these Turpenes without a significant change in operations.

Further identification of halogenated and regulated non-halogenated organic solvents through the source characterization program may lead to additional solvent substitution. As indicated in figure 1, a significant portion of hazardous wastes generated by LANL in 1990 was solvents. Minimization of regulated solvents will significantly lower the operating costs to the Laboratory without significantly affecting productivity.

**II. Waste Characterization**

Where the source characterization study will assist in minimizing the quantities of hazardous wastes generated, waste characterization will provide the data required to properly treat, store or dispose of wastes once generated. LANL generates five types of solid wastes: non-hazardous, infectious, hazardous, radioactive, and mixed wastes.

A solid waste is defined as a solid, semi-solid, liquid, or contained gas which has been discarded, abandoned, recycled, or considered inherently-wastelike (e.g. dioxins). The majority of solid wastes generated in the U.S. are regulated as non-hazardous. These wastes include municipal solid wastes and recyclable products such as glass, paper, and aluminum cans. Hazardous wastes comprise a very small portion of the solid wastes generated yearly in the U.S. Infectious wastes are solid wastes generated from hospitals and biomedical research laboratories. These wastes require special treatment to remove their biohazards prior to disposal. Radioactive wastes are generated either by individuals or corporations licensed by the Nuclear Regulatory Commission (NRC), or federal facilities operated under DOE auspices. The NRC and the DOE are authorized by the Congress to regulate radioactive wastes through the Atomic Energy Act of 1954 (AEA). Mixed wastes are subject to regulation by the AEA and RCRA.

Solid wastes which are infectious, hazardous, radioactive and mixed are managed by the Laboratory's Waste Management Group. With the exception of unused chemical products, these wastes are required to be characterized by the generator who must provide information necessary for proper handling, treatment, storage, and disposal, in compliance with EPA and DOE requirements. The generator of the waste is required to take responsibility for the waste. In the past, the waste generator was only responsible for storing waste properly and notifying the Waste Management Group when it needed to be removed. This practice isolated the waste generator from the waste and caused the Laboratory to spend monies on characterizing wastes to determine proper classification and waste management; and also may have led to the treatment or disposal of non-hazardous wastes as

hazardous. By placing the burden of characterizing the waste on the generator, as much as 98% of the waste currently generated is being characterized through knowledge of the process, thus limiting the need for expensive analysis to Quality Assurance/Quality Control testing.

Waste profiling was initiated in June 1990. Figure 2 shows the number of waste profile requests submitted through March 1991. Between June and December 1990, waste profiles were not mandatory for all infectious, hazardous, radioactive, or mixed wastes. However, by January 1, 1991, all solid wastes handled by the Waste Management Group required an approved waste profile before the waste could be removed from the point of generation. Thus, the number of waste profiles has skyrocketed since the beginning of 1991.

In addition to minimizing the cost of characterizing waste, the waste profile conforms to the waste characterization and acceptance requirements of 40 CFR Parts 264.13(a)(1), 265.13(a)(1), and 268.7(a).

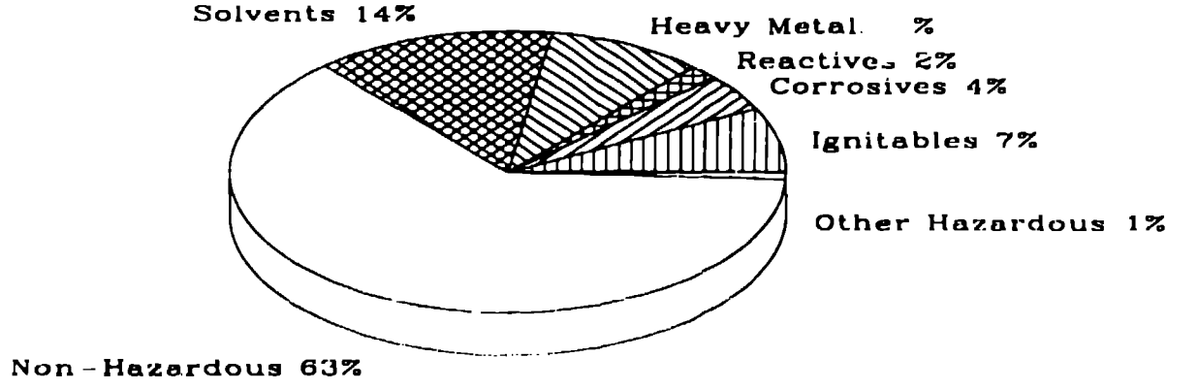


Figure 3. Distribution of Solid Wastes identified by Waste Profiles.

## Summary

Source characterization is essential in minimizing the types and quantities of solid wastes generated by LANL through process changes and material substitutions. Waste characterization insures that wastes are managed in accordance with current management standards while at the same time minimizing waste analysis and waste disposal costs. The high costs of disposing hazardous wastes generated at LANL diminishes the amount of resources made available for research and development. Given that the DOE's research and development budget is imperiled by the federal deficit, and the high costs that will be incurred as a result of remediating contaminated sites within the DOE complex, minimizing the costs of disposing wastes currently being generated has become a high priority. These two projects will lead to a substantial reduction in the cost of managing wastes.

## References

1. RCRAct Facilities Operating Permit, Los Alamos National Laboratory, November 8, 1989.

2. Code of Federal Regulations 40, Parts 260 through 272: July 1, 1990.

3. 1987 New Mexico Hazardous Waste Management Regulations.

4. 1989 New Mexico Solid Waste Management Regulations.

5. Los Alamos National Laboratory Administrative Requirements.

6. HSE-7 Waste Management Database.

7. HSE-8 Waste Profile Database.

8. 1989 Environmental Surveillance Report, Los Alamos National Laboratory, Environmental Protection Group.